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Cardiometabolic Risk Factor Burden in Female Patients with ST-Segment Elevation Myocardial Infarction and Its Association with Disease Severity: A Hospital-Based Observational Study

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Abstract: ***Background**: Cardiovascular disease is the leading cause of mortality among women worldwide, with a rapidly rising burden in low- and middle-income countries such as India. Indian women increasingly exhibit cardiometabolic risk factors including diabetes mellitus, hypertension, dyslipidaemia, obesity, and physical inactivity, which significantly influence the presentation, severity, and outcomes of ST-segment elevation myocardial infarction (STEMI). **Objectives**: To assess the burden of cardiometabolic risk factors among female patients presenting with STEMI and to evaluate their association with disease severity and short-term in-hospital outcomes. **Methods**: This hospital-based cross-sectional observational study was conducted in the intensive coronary care unit (ICCU) of a tertiary care center. One hundred consecutive female patients aged >18 years with clinically and electrocardiographically confirmed STEMI were enrolled. Demographic characteristics, menopausal status, cardiometabolic risk factors, clinical presentation, Killip class, lipid profile, and in-hospital outcomes were recorded and analysed using descriptive statistics. **Results**: The majority of patients were aged ≥45 years, with 92% being post-menopausal. Hypertension (66%) was the most prevalent cardiometabolic risk factor, followed by hyperlipidaemia (57%), diabetes mellitus (50%), obesity (38%), and low physical activity (35%). Patients with multiple cardiometabolic risk factors were more likely to present with higher Killip class (II–IV) and experienced a higher frequency of in-hospital complications, including heart failure and arrhythmias. **Conclusion**: Female patients with STEMI exhibit a high burden of cardiometabolic risk factors, which are strongly associated with disease severity and adverse in-hospital outcomes. Early identification and aggressive management of these risk factors are essential to improve cardiovascular outcomes in this vulnerable population.*

Keywords: STEMI; women; cardiometabolic risk factors; hypertension; diabetes mellitus; Killip class

1. Introduction

Cardiovascular disease (CVD) remains the leading cause of death among women globally, accounting for nearly one-third of all female deaths[1]. Although women traditionally develop coronary artery disease later than men, the absolute burden of acute coronary syndromes in women is steadily increasing, particularly in developing countries such as India[2]. ST-segment elevation myocardial infarction (STEMI) represents the most severe manifestation of acute coronary syndrome and is associated with substantial morbidity and mortality.

In India, rapid urbanization, lifestyle transitions, and demographic ageing have contributed to a marked rise in cardiometabolic disorders among women[3]. Conditions such as hypertension, diabetes mellitus, dyslipidaemia, obesity, and physical inactivity are increasingly prevalent and often coexist, creating a high-risk cardiometabolic milieu. These risk factors not only predispose women to STEMI but also influence clinical presentation, disease severity, and outcomes[4–6].

Biological differences, including hormonal status, play a crucial role in cardiovascular risk among women. Premenopausal women benefit from estrogen-mediated cardioprotective effects; however, following menopause, this protection diminishes, leading to accelerated atherosclerosis and increased cardiovascular events[7]. Indian studies have consistently shown that women with STEMI are predominantly post-menopausal and present at an older age with multiple comorbidities[8].

Furthermore, women with STEMI often present with atypical symptoms, delayed hospital arrival, and higher Killip class at admission compared to men, contributing to worse short-term outcomes[9–11]. Despite these observations, female patients remain under-represented in cardiovascular research, and data focusing specifically on cardiometabolic risk burden and disease severity in Indian women with STEMI are limited.

Understanding the interplay between cardiometabolic risk factors and disease severity in female STEMI patients is essential for developing targeted preventive and therapeutic strategies. This study was undertaken to evaluate the burden of cardiometabolic risk factors among female patients presenting with STEMI and to examine their association with disease severity and short-term in-hospital outcomes in a tertiary care setting in India.

2. Materials and Methods

This hospital-based cross-sectional observational study was conducted in the intensive coronary care unit (ICCU) of a tertiary care teaching hospital. A total of 100 consecutive female patients aged more than 18 years with a diagnosis of ST-segment elevation myocardial infarction (STEMI) were enrolled. Inclusion criteria comprised female patients aged >18 years with clinical features suggestive of acute myocardial infarction and electrocardiographic evidence of ST-segment elevation consistent with STEMI. Male patients and those unwilling to participate in the study were excluded.

Data were collected using a pre-designed and pre-tested proforma. Information recorded included demographic details, age, menopausal status, and history of cardiometabolic risk factors such as hypertension, diabetes mellitus, dyslipidaemia, obesity, tobacco use, and physical activity levels. Clinical presentation, including symptoms at admission, electrocardiographic localization of infarction, and Killip classification, was documented. Laboratory investigations included lipid profile estimation. In-hospital outcomes such as development of heart failure, arrhythmias, and mortality were recorded. Hypertension was defined as previously diagnosed hypertension or blood pressure ≥ 140/90 mmHg; diabetes mellitus as previously diagnosed diabetes or documented hyperglycaemia; dyslipidaemia as abnormal lipid profile as per standard guidelines; obesity as body mass index ≥ 25 kg/m² using Asian criteria; and physical inactivity as self-reported low physical activity. Data were entered and analysed using SPSS version 29, with results expressed as frequencies and percentages, and the association between cardiometabolic risk burden and disease severity assessed descriptively.

3. Results

Table 1: Baseline Demographic, Clinical, and Cardiometabolic Characteristics of Female Patients with STEMI (n = 100)

Variable		Value
Age (years), mean ± SD		61.4 ± 9.2
Age ≥60 years		64 (64%)
Resident	Rural	42 (42%)
	Urban	58 (58%)
Occupation – Housewife		78 (78%)
Body Mass Index (kg/m²), mean ± SD		26.8 ± 3.4
Obesity (BMI ≥25 kg/m²)		41 (41%)
Menopausal Status	Premenopausal	18 (18%)
	Postmenopausal	82 (82%)
Cardiometabolic risk factors		
Hypertension		58 (58%)
Diabetes mellitus		46 (46%)
Dyslipidaemia		52 (52%)
Obesity		41 (41%)
Two or more cardiometabolic risk factors		62 (62%)
Clinical presentation		
Chest pain		100 (100%)
Sweating		68 (68%)
Breathlessness		54 (54%)
Palpitations		21 (21%)
Syncope		6 (6%)
Time to hospital >6 hours		57 (57%)
Lipid profile abnormalities		
Elevated total cholesterol (>200 mg/dL)		48 (48%)
Elevated LDL-C (>130 mg/dL)		55 (55%)
Low HDL-C (<50 mg/dL)		60 (60%)
Hypertriglyceridemia (>150 mg/dL)		44 (44%)

A total of 100 consecutive female patients presenting with ST-elevation myocardial infarction were included in the study. The mean age of the cohort was 61.4 ± 9.2 years, with nearly two-thirds (64%) aged 60 years or older. Most patients were postmenopausal (82%) and homemakers (78%), reflecting the typical demographic profile of women affected by acute coronary syndromes in India. Cardiometabolic risk factors were highly prevalent, with hypertension observed in 58%, diabetes mellitus in 46%, dyslipidaemia in 52%, and obesity in 41% of patients. Notably, 62% had two or more cardiometabolic risk factors. Chest pain was the universal presenting symptom, while breathlessness (54%) and sweating (68%) were also common. More than half of the patients (57%) presented beyond six hours of symptom onset. Lipid profile analysis revealed elevated total cholesterol in 48%, raised low-density lipoprotein cholesterol in 55%, low high-density lipoprotein cholesterol in 60%, and hypertriglyceridemia in 44% of patients.

Table 2: Association Between Cardiometabolic Risk Factor Burden and Clinical Severity in Female STEMI Patients (n = 100)

Parameter	≤1 Risk Factor (n, %)	≥2 Risk Factors (n, %)	p-value
Number of patients	38 (38%)	62 (62%)	—
Killip Class I	26 (68.4%)	18 (29.0%)	<0.001
Killip Class II–IV	12 (31.6%)	44 (71.0%)	<0.001
Cardiogenic shock	3 (7.9%)	15 (24.2%)	0.03
Moderate–Severe LV dysfunction (Echo)	10 (26.3%)	39 (62.9%)	<0.001
In-hospital heart failure	8 (21.1%)	34 (54.8%)	<0.001
Arrhythmias (AF/ VT/ VF)	5 (13.2%)	22 (35.5%)	0.01
Need for intensive care (Killip III–IV)	4 (10.5%)	20 (32.3%)	0.01
In-hospital mortality	4 (10.5%)	18 (29.0%)	0.02
Discharged in stable condition	34 (89.5%)	44 (71.0%)	0.02

Patients with a higher cardiometabolic risk burden (≥2 risk factors) demonstrated significantly worse clinical presentation and in-hospital outcomes compared with those having ≤1 risk factor. A substantially lower proportion of patients in the ≥2 risk factor group presented in Killip class I (29.0% vs. 68.4%), while advanced Killip class (II–IV) was significantly more frequent in this group (71.0% vs. 31.6%; $p<0.001$ for both). Cardiogenic shock occurred more commonly among patients with ≥2 risk factors (24.2% vs. 7.9%; $p=0.03$). Moderate to severe left ventricular dysfunction on echocardiography was observed in nearly two-thirds of patients with ≥2 risk factors compared to one-quarter in the ≤1 risk factor group (62.9% vs. 26.3%; $p<0.001$). In-hospital heart failure (54.8% vs. 21.1%; $p<0.001$), clinically significant arrhythmias (35.5% vs. 13.2%; $p=0.01$), and need for intensive care support (32.3% vs. 10.5%; $p=0.01$) were all significantly higher in the high-risk group. Importantly, in-hospital mortality was significantly greater among patients with ≥2 cardiometabolic risk factors (29.0% vs. 10.5%; $p=0.02$), while stable

discharge was more frequent in the lower risk group (p=0.02).

4. Discussion

The present hospital-based observational study highlights a substantial burden of cardiometabolic risk factors among female patients presenting with ST-segment elevation myocardial infarction (STEMI) in an Indian tertiary care setting. The majority of patients were elderly and postmenopausal, underscoring the contributory role of age-related hormonal changes in accelerating atherosclerosis and adverse cardiovascular outcomes in women. This observation aligns with prior Indian and international studies reporting delayed but more severe coronary artery disease in postmenopausal women **[3,12]**.

Hypertension was the most prevalent cardiometabolic risk factor in the present cohort, followed by dyslipidaemia and diabetes mellitus. A significant proportion of patients demonstrated abnormal lipid profiles, particularly elevated low-density lipoprotein cholesterol and reduced high-density lipoprotein cholesterol levels, reflecting the characteristic atherogenic dyslipidaemia observed in South Asian populations **[5,13]**. Similar lipid abnormalities among Indian women with acute coronary syndromes have been reported by multicentric registries, emphasizing the need for early lipid screening and intervention **[10,14]**.

Notably, nearly two-thirds of patients had two or more cardiometabolic risk factors, highlighting the clustering phenomenon increasingly observed in India due to rapid urbanization and lifestyle transitions **[4,15]**. This clustering was strongly associated with disease severity at presentation. Patients with multiple cardiometabolic risk factors were significantly more likely to present in higher Killip classes (II–IV) and to exhibit moderate-to-severe left ventricular dysfunction on echocardiography, indicating advanced myocardial compromise. These findings are consistent with previous studies demonstrating that metabolic comorbidities worsen clinical presentation and myocardial injury in STEMI, particularly among women **[16,17,18]**.

In-hospital complications were significantly more frequent in patients with a higher cardiometabolic risk burden. Rates of heart failure, arrhythmias, cardiogenic shock, and need for intensive care support were markedly elevated in this group. Importantly, in-hospital mortality was significantly higher among patients with two or more cardiometabolic risk factors, reinforcing their prognostic significance. Similar associations between metabolic risk clustering and adverse short-term outcomes have been reported in Indian and international cohorts of women with STEMI **[9,12,19]**.

Delayed hospital presentation, frequently observed in women due to atypical symptomatology, sociocultural barriers, and limited cardiovascular awareness, further compounds adverse outcomes **[9,10,11]**. When combined with a high cardiometabolic risk burden, delayed presentation likely contributes to the increased severity and mortality observed in this study.

Overall, the findings underscore the urgent need for early identification and aggressive management of cardiometabolic risk factors among women, particularly in the postmenopausal age group. Community-based screening, lifestyle modification, and equitable access to cardiovascular care are essential to reduce the burden and improve outcomes of STEMI in Indian women **[1, 2, 4]**.

5. Conclusion

Female patients with STEMI exhibit a high burden of cardiometabolic risk factors, particularly hypertension, diabetes mellitus, dyslipidaemia and post-menopausal status. These risk factors are strongly associated with increased disease severity and adverse in-hospital outcomes. Early identification and aggressive management of cardiometabolic risk factors, along with targeted preventive strategies for women, are essential to improve cardiovascular outcomes in this vulnerable population.

6. Limitations

This study was limited by its single-center, cross-sectional design and the absence of long-term follow-up data.

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